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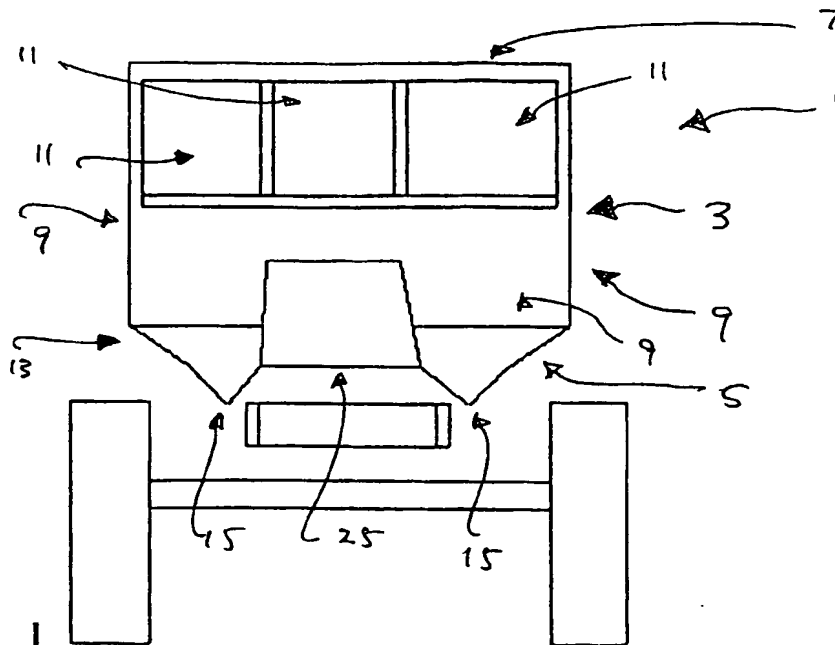
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[Continued on next page]

(54) Title: PROTECTIVE APPARATUS FOR VEHICLES



(57) Abstract: The invention provides a protective apparatus for a vehicle, the apparatus comprising a structure of generally convex shape adapted to be fitted to or to form part of a vehicle, wherein: (a) the protective apparatus is capable of resisting a force applied to the structure; and (b) the apex of the apparatus is disposed generally in a direction that is opposed to the direction of travel or movement of the force applied to the apparatus.



Declaration under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i)) for all designations

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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PROTECTIVE APPARATUS FOR VEHICLES**Field of the invention**

5 This invention relates to protective apparatus for vehicles. It has particular, although not exclusive application to protective devices for the cabins of passenger vehicles, and especially those used in military applications. The background to the invention will therefore be described with particular reference to the military applications to which it is particularly (although not exclusively) suited.

Background to the Invention

10 In many military operations, it is important to be able to use vehicles whose primary purpose is to assist in transporting personnel safely, rather than for the primary purpose of being engaged in combat or hostilities. One of the problems with transporting personnel in areas where military hostilities are occurring, is the potential threat of land mines, bombs or similar devices exploding when a vehicle passes over them, and thereby causing injury or death to the occupants of the vehicle. Even where a vehicle is specifically designed for use in hostilities (eg. tanks and the like), the explosion of a land mine or a similar detonating device as the vehicle passes over it always entails the serious risk of injury or loss to life to its occupants. Where a military truck or a similar vehicle passes over a land mine, the occupants of the vehicle are at particular risk, as such vehicles are frequently not designed specifically to withstand the impact of an explosion generated by a land mine or a similar exploding device.

25 This problem has recently become heightened, through international concerns about the activities of terrorists and terrorist organisations. Apart from the need to have vehicles which can safely transport people in a military context, there are many other situations in which it would also be desirable to have a vehicle which could more safely be used to transport people, where a risk exists that a bomb or an exploding apparatus of some other sort might be located in the ground surface over which the vehicle may pass.

The present invention aims to address this need.

General disclosure of the invention

5 The invention generally provides a protective apparatus for a vehicle, the apparatus comprising a generally convex structure fitted to the vehicle that is capable of resisting a force applied to the structure, in which the apex of the structure is disposed generally in a direction that is opposed to the direction of travel or movement of the force applied to the structure.

10 In a preferred embodiment, the structure is integrally formed as part of the vehicle. In this aspect of the invention, it is particularly preferred that the structure is located in or near to the part of the vehicle in which passengers and/or the driver are housed. In a particularly preferred embodiment of the invention, the part of the vehicle in which the driver and/or passengers are housed takes the form of a cabin or a like enclosure which is designed to house one or more of (a) the driver of the vehicle, (b) one or more other passengers and (c) controlling apparatus for the vehicle. In a particularly preferred embodiment, the structure is
15 integrally formed as part of the vehicle's cabin, and is fitted to the underside of the cabin so that the apex of the structure generally points downwards towards the ground.

20 Alternatively, the structure may take the form of an accessory which is fitted to the vehicle, so as to resist a force applied to a region of the vehicle in which the driver and/or one or more passengers is (or are) housed.

25 In one embodiment of the invention, the structure may have a generally arcuate form, when viewed in cross-section or from another side elevation (eg, when viewed in end-section). In other embodiments of the invention, the cross-sectional profile of the structure is more angular. In a particularly preferred embodiment of the invention, the cross-sectional profile is triangular or quasi-triangular. In some embodiments of the invention however, the cross-sectional profile could be trapezoidal or frusto-trapezoidal. The cross-sectional shape adopted in any particular instance will depend, upon other factors, on the particular use to which the vehicle is to be put.

The vehicle to which the structure is fitted could transport one or more than passengers, including the driver. The vehicle could also be primarily designed for transporting personnel, or alternatively, it could be primarily designed for use in actual hostilities, as desired in any particular instance. In yet other embodiments of the invention, the vehicle could be designed so as to combine both these functions.

Detailed description of preferred embodiments of the invention

Preferred embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Fig 1	represents a side view of a passenger cabin for a vehicle, the cabin having been constructed in accordance with the present invention;
Fig 2	represents a front view of the cabin depicted in Fig 1;
Fig 3	represents a rear view of the cabin depicted in Figs 1 & 2;
Fig 4	represents a front view of the cabin depicted in Figs 1-3 mounted on a 'Unimog' vehicle for use in military operations; and
Fig 5(a)	depicts a cabin constructed in accordance with the present invention, fitted on the front end of a vehicle; and
Fig 5(b)	depicts a conventional cabin for a vehicle of the kind depicted in Fig 5 (a).

Referring now to the drawings, Fig 1 represents a side view of a passenger cabin for a vehicle, the cabin having been constructed in accordance with the principles of the present invention. As will be seen from Fig 1, the cabin (generally denoted (1) in the accompanying drawings) comprises an upper portion 3 (which is adapted, in use, to receive and house one or more passengers, including the driver of the vehicle) and a lower portion (generally denoted 5). In the accompanying drawings, the exemplary cabin is shown as being a structure which is capable of being mounted onto a vehicle. In other words, in the accompanying

drawings, the cabin (1) takes the form of an accessory structure which may be fitted onto a vehicle, either permanently or in some removable manner. Ordinary persons of skill in the art would readily apprehend however, that in some instances, the cabin could be integrally formed with the vehicle.

5 In the accompanying drawings, the upper portion 3 of cabin 1 comprises a structure which may be designed to house not only a driver and/or one or more other passengers, but also, the steering and other controls for the vehicle. The upper cabin portion 3 also comprises a roof section 7, and four walls (each denoted 9 in the accompanying drawings). The upper cabin portion walls 9 also
10 comprise windows (each of these being denoted 11 in the accompanying drawings). Cabin 1 also comprises two doors (each denoted 13).

The lower portion 5 of cabin 1 comprises an apparatus (generally denoted 13, which as seen on side elevation in Fig 1, generally has a convex shape). In the embodiment of the invention depicted in Fig 1, the apparatus 13 comprises a
15 generally triangular structure (when viewed, as shown in Fig 1, in cross-section) and which culminates in an apex (denoted 15). The generally triangular structure 13 is defined by three boundaries (denoted 17, 19 and 21 respectively). Cabin 1 also includes a plurality of mounts (each denoted 23), as shown in side elevation on Fig 1). This configuration means that, as previously mentioned, cabin 1 takes
20 the form of an accessory structure which is able to be fitted onto a vehicle. Figs 4 and 5 (a) show the cabin 1 fitted onto the front end of a vehicle.

In yet other embodiments of the invention, a protective apparatus constructed in accordance with the principles of the present invention could take an arcuate shape when viewed in cross-section or end-section. Such alternative
25 shapes are apprehended by the concept of the invention.

When cabin 1 is fitted to a vehicle in a manner of the kinds previously mentioned, if the vehicle travels over a ground surface which contains a land mine, a bomb or another detonating device, the generally convex (and in the embodiments shown in the accompanying drawings, triangular) cross-sectional
30 profile of the apparatus 13, is such that any force applied to the apparatus 13 by

the land mine, bomb or detonating device would at least to some extent, generally be dispersed or deflected away from the apparatus, by virtue of its shape. In contrast, and having regard more particularly to the type of conventional vehicle cabin shown in Fig 5(b), a conventional vehicle cabin for use in military operations typically comprises a generally flat underneath surface, which would absorb the entirety of the impact of an explosion caused by a bomb, land mine or other detonating device that explodes underneath the cabin.

In the case of a conventional cabin, the cross-sectional profile of the underneath of the cabin is such that the entire impact (or a significant part of the impact) is generally absorbed by the cabin, and frequently, this means that the force applied to the underneath of the cabin will rupture it, resulting in personnel travelling within the cabin being subjected to that force. The net effect of this is to result in death or bodily injury to the occupants of the cabin.

The apparatus 13 of the present invention may be constructed so as generally to have the cross-sectional triangular profile (or another convex profile) of the kind shown in Fig 1. As shown more particularly in Figs 2 and 3 however, the cabin 1 may be designed so that it in fact comprises two generally triangular structures (each denoted 13(a) and 13(b) in Figs 2 and Fig 3 respectively), and a bridging portion (denoted 25) in those drawings. In the embodiment shown in Figs 2, 3 and 5(a), the configuration of the two triangular mounts (13(a) and 13(b), respectively) and the bridging portion is such as to enable the cabin 1 to be fitted conveniently to a chassis or other structure that defines the remainder of the vehicle. Persons of skill in the art would readily apprehend however, that the particular constructional details depicted in Figs 1 to 5(a) inclusive is merely one example of a mounting structure for a vehicle cabin constructed in accordance with the invention, and that many other possibilities are bound within the scope of the invention, without departing from the inventive concept.

The apparatus 13 of the present invention may be constructed from any of a number of suitable materials. Materials suitable for this purpose would readily be known to persons skill of the art, and would include various metallic materials that are known to have superior resistance to the impact of explosions. These

materials would specifically include high ductile steels and materials with similar force or impact-resistant properties. In a particularly preferred construction, all the joins and any surfaces which contain a bend are formed so as to be impervious to the impact of an explosion or detonation. The construction of joins or joints on a cabin made in accordance with the invention (and particularly, the joins/joints on a protective apparatus according to the present invention) could be achieved by any of a number of methods, the nature of which would be understood by ordinary persons of skill in the art. One particularly suitable way of constructing such joins or joints would be to use a continuous seam weld along the join/joint, and additionally, to apply a capping materials (typically also high ductile steel) along the seam weld.

The non-windowed elements of the upper portion (designated 3 in the accompanying drawings) of the cabin could also be made from any number of suitable materials. In general, those elements (as indeed also the windows themselves) would need to be bullet-resistant, in most military applications, especially where it is envisaged that the vehicle might be required to travel through areas where hostilities might be in progress. In such applications, the non-windowed elements could desirably be made from high tensile steels or materials with similar force or impact-resistant properties.

Vehicles fitted with either:

- (a) a cabin which has an integrally formed protective structure; or
- (b) an accessory protective structure

constructed in accordance with the present invention, could either be built *ab initio* with either of those structures, or alternatively, existing vehicles could be fitted with one or other kind of structure. In many military operations, it is also desirable to be able to assemble a vehicle on site at the place where the operations are to be conducted. The present invention is compatible with the principle of vehicles (that are to be fitted with a protective apparatus in accordance with the invention) being constructed in

parts, and later being assembled *in situ*.

Accordingly, the principles of the present invention allow for considerable flexibility in conducting military operations that may need to be carried out remotely from the place where a vehicle that is fitted with a protective apparatus in accordance with the invention, might initially have been constructed.

Persons of skill in the art would also recognise that while the protective structure has been specifically described with reference to its use as a structure fitted to an underneath compartment of a vehicle, the principles of the invention are also applicable to using structures made in accordance with its spirit and scope, in other contexts. For example, convex protective structures of the type described previously might be fitted to other parts of a vehicle, so as to protect those other parts from collateral damage caused by land mines, bombs or other detonating devices with which the vehicle might come into proximity.

The present invention is therefore capable of many modifications, and of being applied to many uses. Accordingly, the spirit and scope of the present invention is not to be limited by reference to the exemplary constructional details or uses of the embodiments described in this specification.

It is to be understood that wherever used in this specification (including in both the description and the claims), forms of the word 'comprise' are equivalent in meaning to the corresponding forms of the word 'include', and are thus not to be taken as excluding or implying the exclusion of a feature or integer.

It will be also understood that the invention disclosed in this specification extends to all combinations of two or more of the individual features mentioned or evident from or implicit in the text of this specification or the accompanying drawings. All such different combinations constitute various alternative aspects of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

- 5 1. A protective apparatus for a vehicle, the apparatus comprising a structure of generally convex shape adapted to be fitted to or to form part of the vehicle, wherein:
- (a) the protective apparatus is capable of resisting a force applied to the structure; and
- 10 (b) the apex of the apparatus is disposed generally in a direction that is opposed to the direction of travel or movement of the force applied to the apparatus.
2. A protective apparatus as claimed in claim 1, in which the protective apparatus is formed integrally with the vehicle.
3. A protective apparatus as claimed in claim 1, in which the protective apparatus is an accessory structure to the vehicle.
- 15 4. A protective apparatus as claimed in claim 3, in which the protective apparatus is an accessory structure which is capable of being fitted to the vehicle, either permanently or removably.
- 20 5. A protective apparatus as claimed in any of the preceding claims, in which the generally convex shape of the apparatus is a generally arcuate shape when viewed in cross section or from a side elevation.
6. A protective apparatus as claimed in either of claims 3 or 4, wherein the apparatus has a generally triangular or quasi-triangular shape when viewed in cross section or from a side elevation.
- 25 7. A protective apparatus as claimed in any one of claims 3, 4 or 5, wherein the apparatus has a generally trapezoidal or frusto-trapezoidal shape, when viewed in cross section or from a side elevation.

8. A protective apparatus as claimed in any of the preceding claims, wherein the vehicle is formed so as to be capable of transporting one or more persons when the vehicle is in motion.
- 5 9. A protective apparatus as claimed in claim 8, wherein the protective apparatus takes the form of a cabin capable of housing one or more persons when the vehicle is in motion.
10. A protective apparatus as claimed in claim 9, wherein the cabin comprises one or more door means, through which in use, a person may enter or leave the cabin.
- 10 11. A protective apparatus as claimed in claim 10, wherein the cabin is made from, or comprises structures made from high tensile steel.
12. A protective apparatus as claimed in claim 9, wherein the cabin comprises one or more window means.
- 15 13. A protective apparatus as claimed in claim 12, wherein each of the one or more window means is made from or comprises materials that are capable of resisting the impact of:
- (a) an explosion;
- (b) a detonated device
- (c) a bullet; or
- 20 (d) a ballistic missile.
14. A protective apparatus as claimed in any of claims 8, 9, 10, 11 or 12, wherein the portion or those portions of the protective apparatus that do not comprise window means are made from one or more materials that are capable of resisting the impact of:

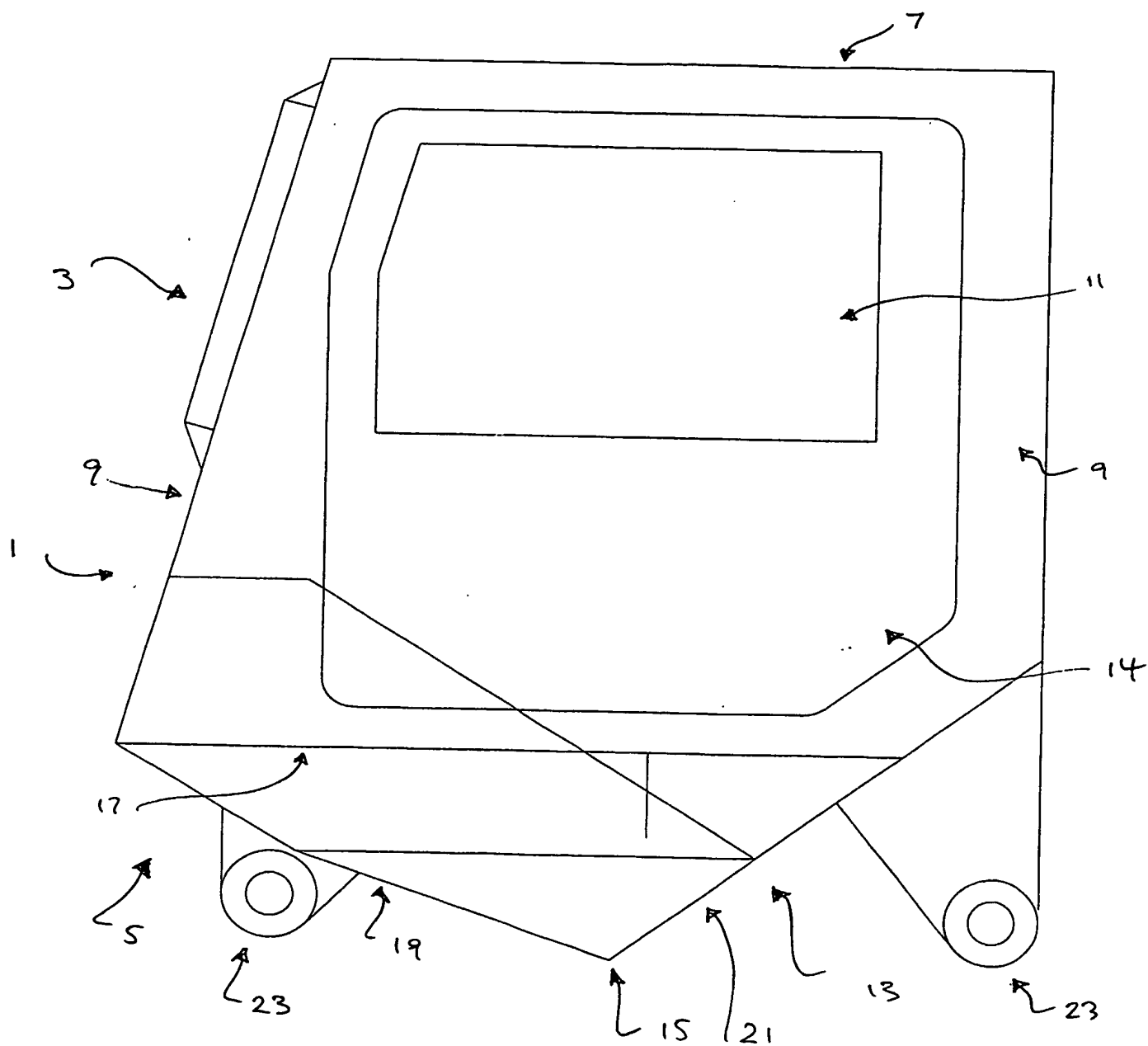
- (a) an explosion;
- (b) a detonated device
- (c) a bullet; or
- (d) a ballistic missile.

- 5 15. A protective structure, as claimed in any of the preceding claims, in which the protective structure takes the form of a structure which is fitted to an underneath side of the vehicle.
16. A protective structure for a vehicle, substantially as disclosed in this specification, and with reference to the accompanying drawings.
- 10 17. A vehicle comprising a protective structure as claimed in any one of claims 1 to 13, substantially as disclosed in this specification, and with reference to the accompanying drawings.

DATED: 22 January 2004

VALIR PTY LTD (ACN 102 320 856)

15 By its Registered Patent Attorneys
MINTER ELLISON PATENT ATTORNEYS

*Fig 1*

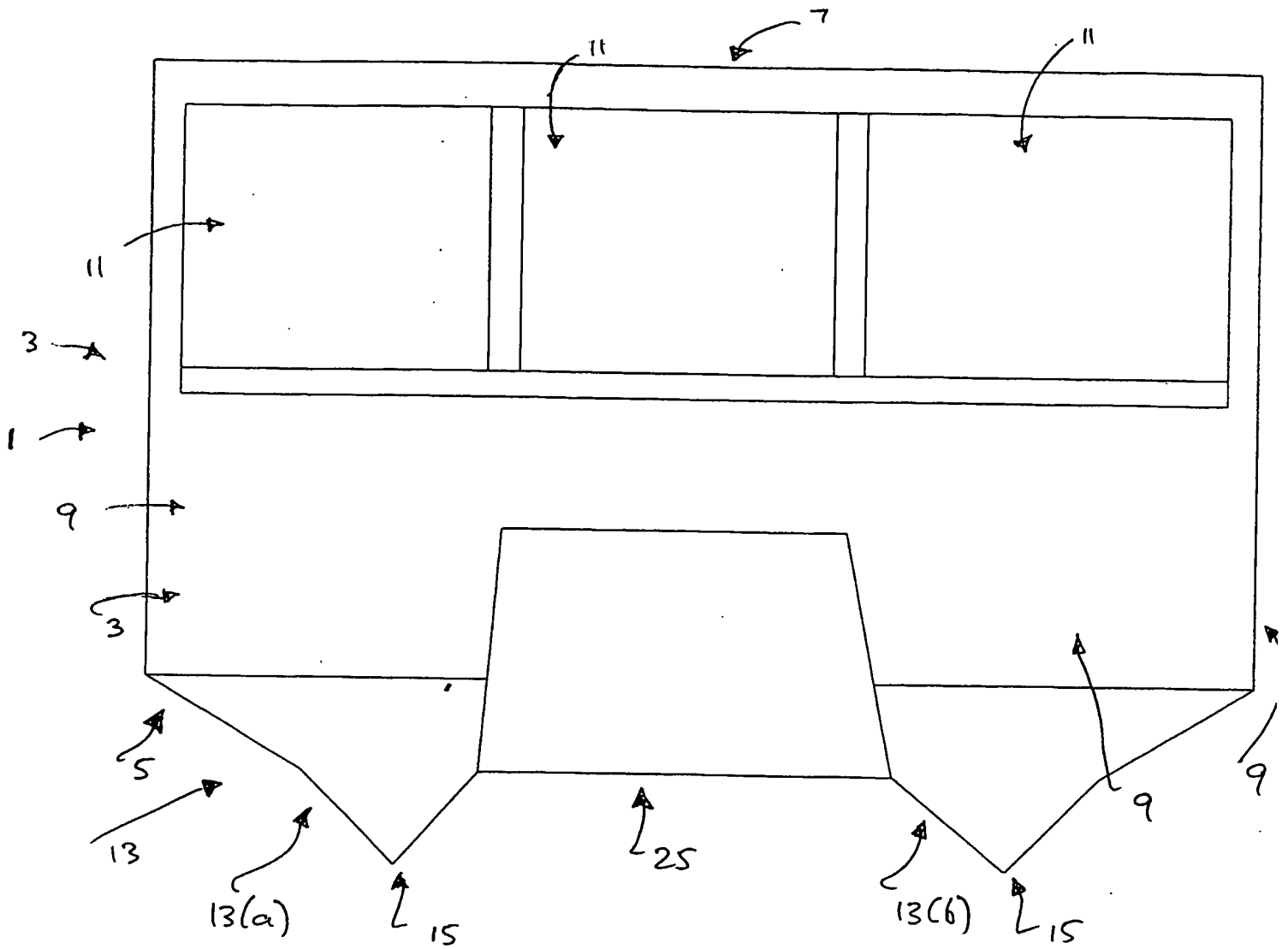
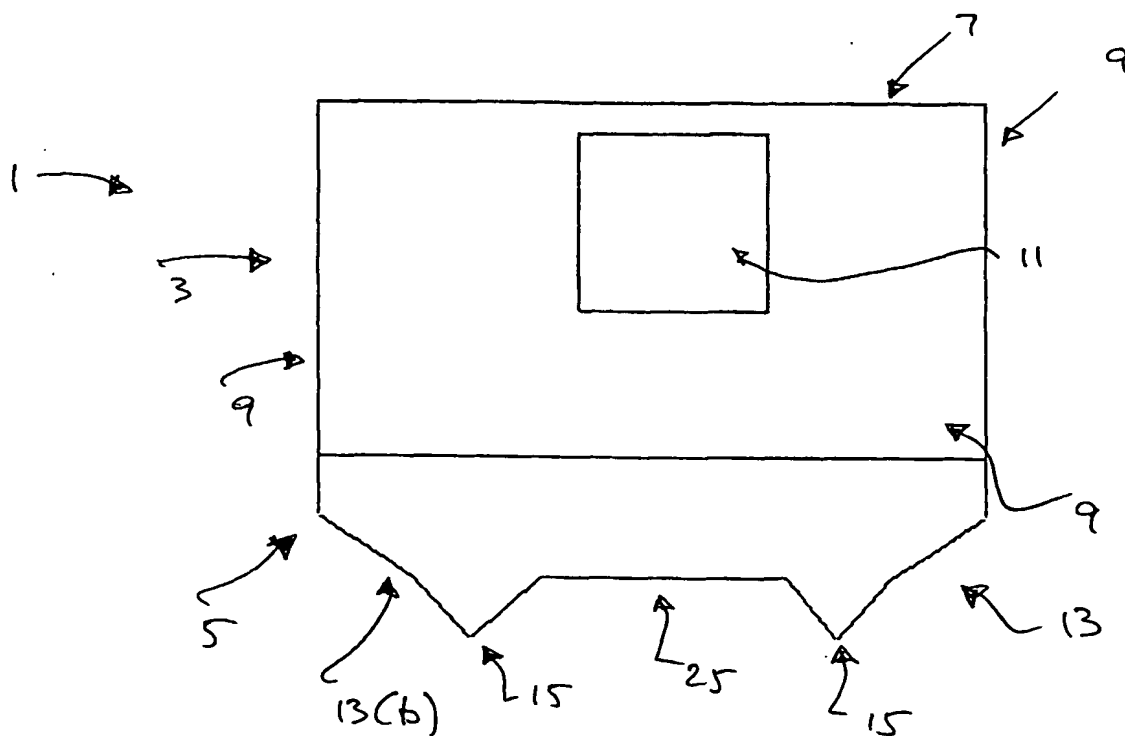
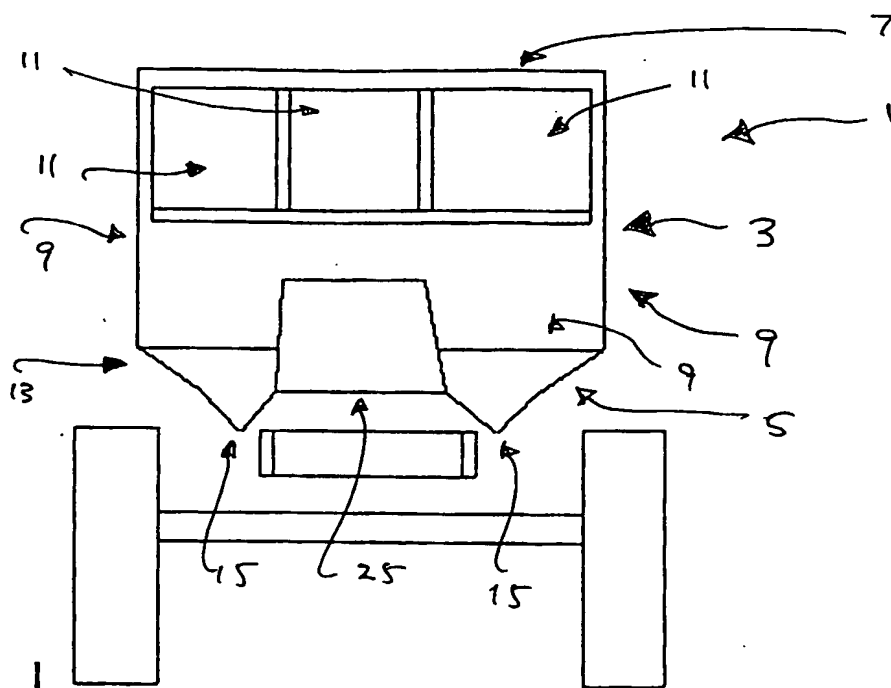


Fig 2

*Fig 3*

*Fig 4*

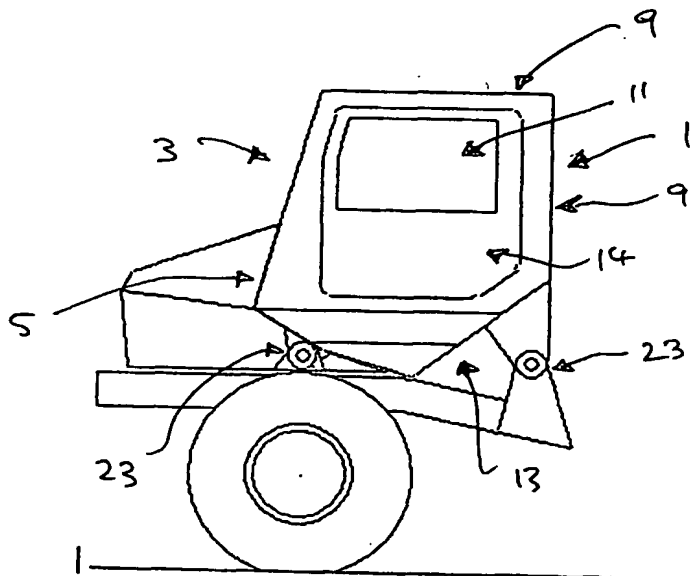


Fig 5(a)

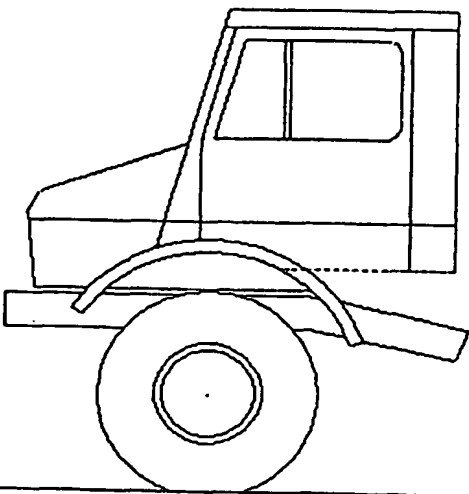


Fig 5(b)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2003/001658

A. CLASSIFICATION OF SUBJECT MATTERInt. Cl. ⁷: F41H 7/04, 5/013

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI IPC F41H 7/04, 5/013, 5/00

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2052695 A (LEGUEU) 28 January 1981 Whole document	1 - 6, 8 - 15
X	AU 42221/96 (703896) B2 (REUNERT MECHANICAL SYSTEMS LIMITED) 1 April 1999 Whole document	1 - 6, 8, 9, 12 - 15
X	WO 2002/039048 A2 (VICKERS OMC (PROPRIETARY) LIMITED) 16 May 2002 Whole document	1 - 6, 8, 13



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
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Date of the actual completion of the international search
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2003/001658

C (Continuation).

DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US 6658984 B2 (ZONAK) 9 December 2003 Whole document	1 - 5, 8, 13
A	US 4326445 A (BEMISS) 27 April 1982 Whole document	1 - 15

INTERNATIONAL SEARCH REPORT

International application No.

Information on patent family members

PCT/AU2003/001658

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
GB	2052695	AU	59302/80	BE	883869
		CH	638037	DE	3017078
		FR	2459445	GR	68768
		NL	8003337	NO	801789
		PT	71165	SE	8004378
BR	8003567	ES	8103367	JP	56005272
		OA	6548	ZA	8002455
AU	42221/96	ZA	9608756		
WO	02/39048	NONE			
US	6658984	DE	10134394	EP	1275928
		US	2003010189	NO	20022225
US	4326445	CA	1163287		
END OF ANNEX					